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Effectiveness of phytobiotic for prophylactic non-contagious gastrointestinal diseases in suckling piglets

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Abstract

The article presents the results of prophylactic effectiveness phytobiotic feed additive XTRACT™ 6930 for non-contagious diseases of the gastrointestinal tract in the composition of the basic diet of suckling pigs on modern pig farm. Diseases of the gastrointestinal tract make up from 40 to 60% of internal pathology in pigs. Used phytobiotic XTRACT™ 6930 with preventive measures, which had positive influence on oxygen-transport function of blood, hemoglobin synthesis and erythrocytopoesis in animals, as indicated by the number of erythrocytes, MCH and hematocrit in blood of suckling piglets from experimental group. Feeding of XTRACT™ 6930 had also positive influence on leukopoesis, as indicated by increased leukocyte rate in blood of suckling piglets from experimental group within physiological fluctuations. Increase of leukocyte rate can be caused by stimulation of non-specific resistance in piglets, which plays main role in defence of animals during early ontogenesis. As it is known, stabilization of phagocytic activity of leukocytes occurs during first months of age, when the body of pigs is able to synthesize most humoral factors of protection. Application of suckling piglets feed additive XTRACT™ 6930 for 18 days resulted in a positive impact on metabolism: increased levels of total protein, albumin, glucose serum; reduced levels of urea, phosphorus; reduced the activity of ALT, AST, ALP and GGT within physiological fluctuations. The use of phytobiotic feed additive XTRACT™ 6930 in experimental group of piglets increased the survival of piglets from experimental group in sucking period compared with control group of animals by reducing the percentage of morbidity and mortality from non-contagious diseases of the gastrointestinal tract. Consequently, it was established that the use XTRACT™ 6930 has positive effect on biochemical blood parameters of piglets, decreases their morbidity and mortality before weaning.

Key words: suckling piglets, phytobiotic, hematological and biochemical blood tests, non-contagious diseases, gastrointestinal tract, morbidity, mortality, preservation.

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1. Introduction

One of the most important scientific and practical problems of modern pig breeding is to increase the preservation of piglets in conditions of industrial animal production. Periods of intensive growth and development are considered to be the most critical stages of ontogenesis, because in addition to technological factors, age-related immune deficiencies are developed, which are accompanied by the development of diseases, including the gastrointestinal (Todoriuk et al., 2016; Jayaraman and Nyachoti, 2017; Solà-Oriol and Gasa, 2017).

As a result of the intensification and transition pig industry on an industrial scale significantly increased morbidity and mortality of young pigs from non-contagious diseases. In particular, this applies to diseases of the gastrointestinal tract, which make up from 40 to 60% of internal pathology. Gastrointestinal diseases of non-contagious etiology in piglets during suckling period, lead to low weight at weaning, which negatively affects their further development and survival (Pluske et al., 2018). Their effective prevention can decrease mortality of animals and improve quality of their products.

Known methods of preventing diseases of the digestive system, involve use of antibiotics, sulfonamides and nitrofurans, which violate microbial ecosystem of the digestive tract and have a number of other negative consequences. Following the adoption of the ban for use of feed antibiotics in the European Union, the interest has been growing to natural and safe drugs (Cromwell, 2002; Chowdhury et al., 2009; Holman and Chénierab, 2015).

Among them are phytobiotics – drugs or feed additives containing incorporates essential oils, plant extracts, natural alkaloids or alcohols. They have antibacterial properties, create favorable conditions for the growth of Lactobacillus gut and inhibit the growth of pathogenic organisms, stimulate appetite, improve digestion and feed (Kommera et al., 2006; Jacela et al., 2010; Kiczorowska et al., 2017). Several

authors (Vidanarachchi et al., 2005; Costa et al., 2013), which studied the use of phytobiotics for piglets, also point out increasing growth parameters and preservation.

Research objective was to determine prophylactic effectiveness of phytobiotic XTRACT™ 6930 as part of the basic diet for non-contagious gastrointestinal diseases in suckling piglets on modern pig farm.

2. Materials and methods

The studies were performed on pig farm. The object of the research were clinically healthy piglets (Landrace; n = 40) aged 10 days, selected on the basis of analogues (age, sex, weight).

Experimental group of piglets from the age of 10 to 28 days received additionaly to feed made fodder additive XTRACT™ 6930 (Pancosma S.A., Switzerland) at dose of 0,15 g/kg in accordance with the recommendations in the guideline to use.

The material for the study was blood, obtained from the vena cava cranialis on the 10th (before feeding XTRACT™ 6930), 20th and 28 days of age (before weaning from the sow). Blood samples were tested for erythrocytes (RBC), hemoglobin (Hb), hematocrit (HCT), leukocytes (WBC), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC). Serum samples were tested for total protein (TP), albumin (Alb), urea (Urea), creatinine (Crea), glucose (Glu), total bilirubin (TB); activity of aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (ALP), gamaglutamiltransferase (GGT); content of calcium (Ca) and phosphorus (P). Hematological and biochemical blood tests were performed at the laboratory of animal internal diseases and clinical diagnostic at Stepan Gzhytskyi National University of Veterinary Medicine and Biotechnologies Lviv using hematological analyzer Mythic 18 (Orphee S.A., Switzerland) and biochemical analyzer BS-120 (Shenzhen Mindray Bio-Medical Electronics Co., Ltd., China) with PZ Cormay S.A. (Poland) reagents.

To control the preservation we formed control (n = 134) and experimental group (n = 137) of clinically healthy piglets selected on the basis counterparts, who were in the same housing. The piglets were followed up from 10th to 28-day of age (before weaning from the sow), with detection of morbidity and mortality due to non-contagious diseases of gastrointestinal tract.

Clinical status was controlled 24 hour per day, throughout the research period by standard methods of veterinary medicine (Vlizlo et al., 2012).

All experimental data were processed by standard methods of mathematical statistics using statistical package of Microsoft Excel 2013, assessing the probability of the indicators ($P < 0.05$; $P < 0.01$; $P < 0.001$) according to Student's t-test.

In conducting experimental studies, all bioethical norms were observed in relation to animals that meet the requirements of the Law of Ukraine "On the protection of animals from cruel treatment" and European Convention for the Protection of Vertebrate Animals used for Experimental and other Scientific Purposes (Official Journal of the European Union).

3. Results and discussion

At the beginning of experiment the blood erythrocyte rate in suckling pigs of experimental (EG) and control (CG) group was in the range 4.7–6.4 × 10^{12}/L and in average 5.8 ± 0.09 i 5.6 ± 0.10 × 10^{12}/L comparing to normal levels 5–8 × 10^{12}/L.

On the 20th day of life the blood erythrocyte rate in animals from control group was significantly lower on 8.6% ($P < 0.01$) comparing with the beginning of experiment and was in average 5.3 ± 0.09 × 10^{12}/L (4.6–6.0 × 10^{12}/L). No significant changes of this parameter revealed in experimental group.

On the 28th day of piglets life this parameter in control group was in the range 4.7–6.2 × 10^{12}/L and in average 5.5 ± 0.10 × 10^{12}/L and was significantly lower on 5.2% ($P < 0.01$) comparing to 10th day. In the experimental group of pigs erythrocyte level was in average 6.0 ± 0.11 × 10^{12}/L (4.9–6.5 × 10^{12}/L) and was significantly higher on 7.1% ($P < 0.05$) comparing to the 10th day and on 9.1% ($P < 0.01$) comparing to the 20th day of animals life and control group.

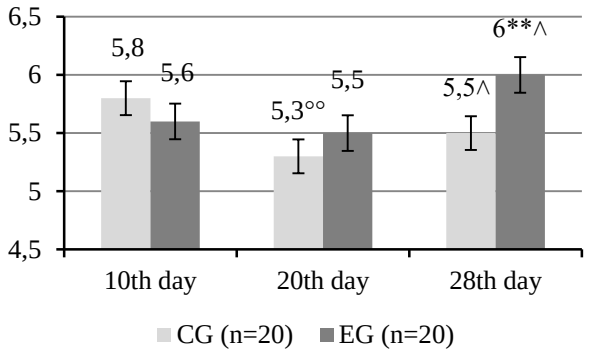

Fig. 1. The blood erythrocyte rate in suckling piglets (10^{12}/L)

Note: In this and the following figures, the difference is statistically significant

* – $P < 0.05$; ** – $P < 0.01$ (experimental group compared to control)

° – $P < 0.05$; °° – $P < 0.01$ (20th day compared to 10th)

' – $P < 0.05$; " – $P < 0.01$ (28th day compared to 20th)

^ – $P < 0.05$; ^^ – $P < 0.01$ (28th day compared to 10th)

At the beginning of experiment the hemoglobin blood level in suckling piglets from control and experimental group was in average 95.2 ± 1.65 i 94.7 ± 1.92 g/L respectively with normal values (90–120 g/L).

On the 28th day of animal's life this parameter in piglets from experimental group was in average 99.3 ± 1.82 g/L (77.8–106.3 g/L) and was significantly higher on 6.3% ($P < 0.05$) comparing to control group.

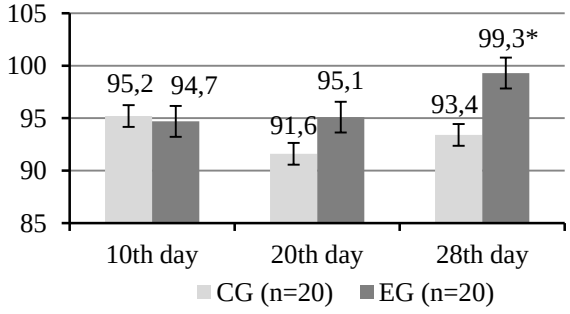

Fig. 2. Hemoglobin blood level in suckling piglets (g/L)

At the beginning of experiment hematocrit in suckling piglets from control and experimental groups was in the range 28.6–41.4% and in average 36.7 ± 0.71 i 37.1 ± 0.66% respectively with normal values 35–43%.

Feeding of XTRACT™ 6930 to suckling piglets contributed to increase of hematocrit in blood of experimental group on 28th day and was in average 39.2 ± 0.63% (33.2–42.6%) and was significantly higher on 7.1 (P < 0.01) and 5.7% (P < 0.05) comparing to 20th and 10th days, and on 9.5% (P < 0.01) comparing to control group – 35.8 ± 0.68% (30.5–41.3%).

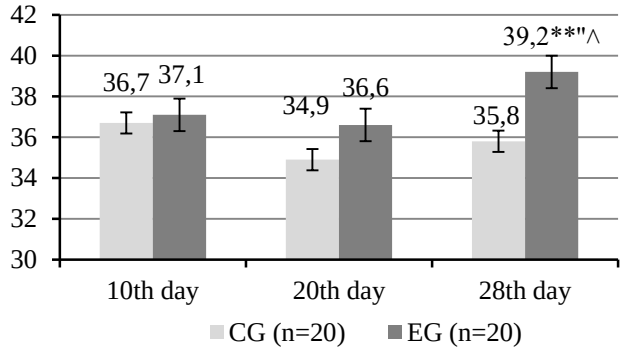

Fig. 3. Hematocrit blood value in piglets (%)

During whole experiment in piglets from control and experimental groups MCV was within physiological fluctuations (50–68 fl).

Decrease of MCH was determined in 10% of piglets 10 days old in control and experimental groups with normal value 16–21 pg. Percentage of animals from control with decrease of MCH during whole experiment remained without changes, while in control group it increased to 20% on the 28th day of life.

According to blood tests at the beginning of experiment 10% of piglets from control and experimental groups had erythrocytopenia, oligochromemia, low hematocrit and MCH, which indicates development of anemia. On the 28th day of life percentage of animals with this parameters in experimental group did no change, while in control group increased to 20% and symptoms of anemia were diagnosed.

Dynamics of parameters can be explained by peculiarities of piglets in suckling period. As it is known, critical status of organism is on 18–20 day of life, when amount of nutrients in mother's milk decrease, colostral antibodies fall, and lead to second phase of insufficiency of immune system. At this age low amount of ferum comes from mother's milk and disturbs normal microflora of the gastrointestinal tract and activated pathogenic. On the background of decreased general resistance and immune reactivity anemia and diseases of the gastrointestinal tract develop.

That is why we used phytobiotic XTRACT™ 6930 with preventive measures, which had positive influence on oxygen-transport function of blood, hemoglobin synthesis and erythrocytopoesis in animals, as indicated by the number of erythrocytes, MCH and hematocrit in blood of suckling piglets from experimental group (Trckova et al., 2014; Czech et al., 2018).

Feeding of phytobiotic XTRACT™ 6930 had also positive influence on leukopoesis, as indicated by increased leukocyte rate in blood of suckling piglets from experimental group within physiological fluctuations (8–16 G/l) on 20th and 28th days of life on 13.6% (P < 0.05) and 19.6% (P < 0.001) respectively, comparing to control group.

Increase of leukocyte rate can be caused by stimulation of non-specific resistance in piglets, which plays main role in defence of animals during early ontogenesis. As it is known, stabilization of phagocytic activity of leukocytes occurs during first months of age, when the body of pigs is able to synthesize most humoral factors of protection (Zhu et al., 2016).

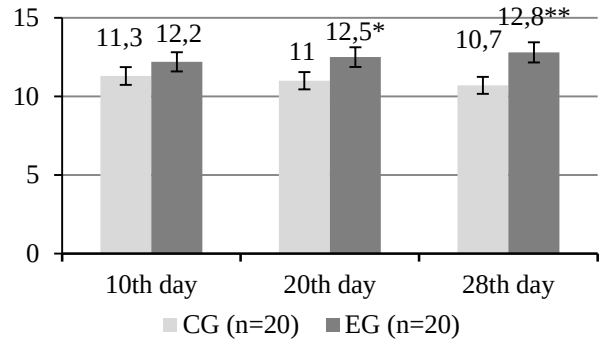

Fig. 4. The leukocyte rate in blood of suckling piglets (G/l)

As a result of XTRACT™ 6930 use in suckling piglets we observed marked decrease (Table 1) of total serum protein on 20th day, but on 28 day of life this parameter was significantly (P < 0.01; 0.05) higher compared to 20th and 10th day 5.7% and 3.8% respectively. Albumin level was significantly (P < 0.01; 0.05) higher on day 28th day compared to 10th and 20th day 12.5% and 10.0% respectively. The increase of these indicators was within the physiological normal levels, which indicates the intensification of many endogenous and exogenous substances transport (Ma et al., 2015; Zhu et al., 2016; Yang et al., 2016).

The intensity of protein metabolism in piglets was evaluated by the content of serum urea.

Serum urea levels in suckling pigs was significantly (P < 0.001) decreased on the 20th and 28th days compared to levels the beginning of the experiment, 24.0% and 30.6% respectively. Reduction of urea in the blood serum of experimental piglets is apparently caused by increased protein metabolism during suckling period (Zhu et al., 2016; Yang et al., 2016).

Regardless serum creatinine of piglets on 20th day, it was increased (P < 0.001) comparing to 10th day to 20.7%, and on 28th – to 23.6%. This metabolite positively correlates with the intensity muscle tissue growth, thus suggesting a higher intensity of synthetic processes in muscles during suckling period (Zhu et al., 2016).

Serum glucose was significantly (P < 0.05) higher on the 28th day of age comparing to the beginning of the experiment, which indicates increased use of fatty acids in energy metabolism (Ma et al., 2015).

Table 1
Serum biochemical parameters in experimental group of piglets (M ± m; n = 20)

Parameter	Age, day		
	10	20	28
TP, g/l	65.9 ± 0.79	64.7 ± 0.87	68.4 ± 0.69 °^^
Alb, g/l	35.1 ± 0.92	35.9 ± 0.44	39.5 ± 0.97 °°^
Urea, mmol/l	4.9 ± 0.15	3.7 ± 0.13 ***	3.4 ± 0.12 °°°
Crea, mkmol/l	96.7 ± 1.59	116.7 ± 3.04 ***	119.5 ± 1.92 °°°
Glu, mmol/l	5.4 ± 0.14	5.7 ± 0.16	5.9 ± 0.13 °
TB, mkmol/l	6.3 ± 0.12	5.8 ± 0.15 *	5.4 ± 0.12 °°°^
ALT, U/l	39.9 ± 0.84	30.7 ± 0.88 ***	29.7 ± 0.71 °°°
AST, U/l	53.6 ± 0.81	33.2 ± 1.06 ***	31.6 ± 0.51°°°
ALP, U/l	163.4 ± 2.67	146.9 ± 1.77 ***	145.2 ± 1.35 °°°
GGT, U/l	48.7 ± 0.85	25.6 ± 0.99 ***	24.1 ± 0.87 °°°
Ca, mmol/l	2.8 ± 0.05	2.7 ± 0.03	2.7 ± 0.06
P, mmol/l	2.6 ± 0.09	2.2 ± 0.06 **	2.2 ± 0.04 °°°

Note: * – P < 0.05; ** – P < 0.01; *** – P < 0.001 (20^{th} day compared to 10^{th})
° – P < 0.05; °° – P < 0.01; °°° – P < 0.001 (28^{th} day compared to 10^{th})
^ – P < 0.05; ^^ – P < 0.01; ^^^ – P < 0.001 (28^{th} day compared to 20^{th})

Level of total bilirubin in serum of suckling piglets was significantly (P < 0.05; 0.001) decreased on 20^{th} and 28^{th} day to 7.9% and 14.3% respectively compared to 10^{th} day. Reduction of this indicator was not pathological as levels were within physiological norms (Ma et al., 2015; Zhu et al., 2016; Yang et al., 2016).

The use of XTRACT™ 6930 in feeding of piglets decreased serum aminotransferases activity comparing to the beginning of experiment. Thus, the activity of ALT decreased on 20^{th} day to 23.1% and on 28^{th} day to 25.6% (P < 0.001). The activity of AST also decreased on 20^{th} and 28^{th} day to 38.1% and 41.1% respectively (P < 0,001). This indicates a positive impact of feed additive on functional condition of the liver.

High activity of alkaline phosphatase in pigles at the beginning of the experiment is caused by intense synthesis of osteoblasts in bone tissue due to active process of growth (Yang et al., 2016). The activity of alkaline phosphatase in the serum of piglets significantly (P < 0.001) decreased on 20^{th} and 28^{th} day comparing to 10^{th} day 10.1% and 11.1% respectively.

At the beginning of the experiment serum GGT activity in piglets was high (Table 1) due to the first portion of colostrum intake, which has a high degree of activity of this enzyme (Ma et al., 2015). After feeding XTRACT™ 6930 activity of GGT in serum to decreased to 50.5% (P < 0.001) on 28^{th} day comparing to 10^{th} day, and to 47.4% on 20^{th} day comparing to 10^{th} day.

Evaluation of serum calcium levels in piglets, fed by phytobiotic feed additive, did not reveale significant changes. However, the content of inorganic phosphorus was significantly (P < 0.001) decreased to 15.4% within physiological norms on 20^{th} day and remained at constant level. The high content of inorganic phosphorus on 10^{th} day confirms its increased content in newborns when fed colostrum and milk.

The use of feed additive XTRACT™ 6930 in experimental group (EG) of piglets reduced their morbidity and mortality from non-contagious diseases of the gastrointestinal tract and thus increased their preservation in suckling period to 6.8% compared to control group (CG) animals (Table 2).

Table 2
Prophylactic effectiveness of XTRACT™ 6930 for non-contagious diseases of the gastrointestinal tract of piglets during the period of experiment

Group	Morbidity		Mortality	
	quantity	%	quantity	%
CG (n = 134)	38	28.4	11	8.2
EG (n = 137)	26	18.9	2	1.4

4. Conclusions

1. Used phytobiotic XTRACT™ 6930 with preventive measures, which had positive influence on erythrocytopoesis in animals, as indicated by the number of erythrocytes, MCH and hematocrit in blood of suckling piglets from experimental group.

2. Feeding of XTRACT™ 6930 had also positive influence on leukopoesis, as indicated by increased leukocyte rate in blood of suckling piglets from experimental group within physiological fluctuations.

3. Application of suckling piglets phytobiotic feed additive XTRACT™ 6930 for 18 days resulted in a positive impact on metabolism: increased levels of total protein, albumin, glucose serum; reduced levels of urea, phosphorus; reduced the activity of ALT, AST, ALP and GGT.

4. Using of phytobiotic XTRACT™ 6930 for piglets of experimental group increased their preservation in suckling period due to lower morbidity and mortality from non-contagious diseases of the gastrointestinal tract.

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